CHAPTER IV

CURRENT EFFORTS TO ESTIMATE NATURAL RESOURCE DEPLETION AND ENVIRONMENTAL DEGRADATION: SOME ILLUSTRATIVE CALCULATIONS

The Bureau of Economic Analysis and the United Nations' Statistical Office have already begun research to incorporate more information on natural resources and the environment into national accounts. These efforts concentrate on two aspects of green accounting: (1) determining the monetary value of environmental degradation and resource depletion and (2) identifying pollution abatement and control expenditures.

Determining the monetary value of environmental degradation and resource depletion addresses the concern that the national accounts do not record changes in environmental quality or most natural resource stocks. Concerns that the accounts do not identify environmental services included in measurements of national income and hide the costs of reducing pollution damages are being addressed by identifying the costs of pollution abatement and control. These initial efforts do not attempt to redefine the production boundary, an undertaking that is necessary to address the concern (described in Chapter I) that the current measures of national income exclude many of the services provided by natural resources and the environment.

The focus of these initial efforts is logical because it is possible to estimate environmental degradation and the depletion of natural resources largely on the basis of market data about the costs of maintaining environmental quality and revenues from goods and services provided by natural resources. Also, many of the costs of reducing pollution damages can be estimated on the basis of data already collected in compiling the national accounts.[1] Certain abatement and control activities are left out. For example, the accounts do not have data on plant closings, delays in plant construction, or curtailments in the use of chemicals in manufacturing and agriculture that may have been caused by efforts to reduce pollution. The costs of such activities, when related to efforts to reduce pollution, are indeed part of pollution abatement costs. Finally, the accounts do not have data for nonmarket activities such as volunteer litter removal.

Current data do not, however, include the value of final service flows from natural capital. These services are not included in the current definition of gross domestic product but could be in a definition of "green" GDP.

1. Department of Commerce, *Survey of Current Business*, vol. 71, no. 11 (November 1991), p. 46.

Expanding the production boundary to broaden the definition of GDP requires much greater reliance on imputed prices.

Both types of effort--determining from data about use and accidents the monetary value of environmental degradation and resource depletion and identifying expenditures for pollution abatement and control--are difficult. One of the more important problems in identifying pollution abatement and control expenditures has been avoiding double counting of expenditures. Companies do not always subtract purchases of equipment from the total of reported expenditures. The problems of determining the monetary value of environmental degradation and resource depletion illustrate the obstacles encountered in any effort to address the other criticisms of the accounts because assigning value to these services will also depend on accurate measurement of and changes in stocks.

VALUING DEPLETION OF NATURAL RESOURCES

Natural resource assets provide marketed flows that contribute to GDP. Although their relative contribution varies from year to year, agriculture, forests, fisheries, coal, oil, and gas sectors contribute about 4 percent to value added in the United states. One objective of expanding the accounts by widening the asset boundary is to adjust net product for the depletion of natural resource assets.

The most common approach to placing a value on the depletion of natural resource assets is the net rent method. The net rent method calculates resource depletion as the marginal rent (the difference between the current market price of the good or service produced by an asset and the marginal cost of production or extraction) times the change in the stock. Recent pilot studies conducted by the U.N. Statistical Office use the net rent method for estimating the depletion of renewable and nonrenewable resources.

In a World Bank study that examines mineral stocks, economists J.M. Hartwick and A.P. Hageman propose a method of estimating depletion that accounts for discoveries of exhaustible resources.[2] The depletion equation can be separated into two parts. The first part uses the net rent method and is equal to the current-period marginal rent (price minus marginal cost) times the amount extracted. In the second part, this estimate is corrected for

2. John M. Hartwick and A.P. Hageman, *Economic Depreciation of Mineral Stocks and the Contribution of El Serafy*, Environment Department Divisional Working Paper No. 1991-27 (Washington, D.C.: World Bank, November 1991).

discoveries by subtracting the incremental cost of discovery multiplied by the amount discovered in the accounting period. (Table 7 shows estimates of depletion for U.S. oil, using this formula to account for discoveries.) These results generally follow market conditions that reflect the changes in price over the decade. Estimates of the value of oil depletion range from about 2 percent of GDP in the early 1980s to less than 1 percent in the period from 1985 to 1990.

Estimates of the value of depletion are a function of the model assumptions used to estimate the value of the stock of reserves. In each model the underlying assumption is that the value of the stock is equal to the

TABLE 7. ILLUSTRATIVE ESTIMATES: VALUING THE DEPLETION OF OIL USING THE NET RENT APPROACH MODIFIED TO ALLOW FOR DISCOVERIES (In billions of 1987 dollars)

	U.S. Oil	
	Crude Oil Prices per Barrel	Value of Depletion Using Net Rent Method[a]
1981	40.3	63.0
1982	34.0	54.6
1983	30.0	50.9
1984	28.4	49.6
1985	25.5	45.4
1986	12.9	19.3
1987	15.4	27.4
1988	12.1	19.1
1989	14.6	23.4
1990	17.7	29.8

SOURCES: Congressional Budget Office based on data from Department of Energy, Energy Information Administration, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, various years (for proven reserves, use, and discoveries), and *Performance Profiles of Major Energy Producers*, various years (for market price, lifting (extraction) costs, and cost of discovery (exploration)).

a. Depletion based on total U.S. proven reserves allowing for discoveries and use.

discounted present value of income (profits). Any estimate of this value depends on assumptions about future prices, demand, and supply. Varying the assumptions of this model or choosing another model could yield very different estimates of depletion.[3] For example, a joint study by the United Nations, the World Bank, and the Mexican Instituto Nacional de Estadistics derived estimates for the stock of oil in Mexico. The values reported varied by as much as a factor of seven under alternative modeling approaches.

VALUING ENVIRONMENTAL DEGRADATION

Emissions cannot be used to measure changes in environmental stocks because pollution is almost always associated with natural capital that has some regenerative powers. Water and air sheds are examples of resources that usually regenerate themselves. But the speed of regeneration depends upon many factors, including the rate of pollutant discharges and the chemical nature of the pollutants (radioactive material is clearly a longer lasting and more dangerous kind of discharge than smoke).

The air quality index used below is a population-weighted average of the uniform air quality index for major metropolitan areas (see Box 2). The water quality index is based on biological oxygen demand estimates for municipal waste treatment plants throughout the United States. Both indexes represent physical measurements of environmental stocks that generate flows of service in the economy (see Table 8).

In this example, degradation is based on the amount by which the quality index falls since the beginning of the year if there are no further efforts to abate pollution. The results in Table 8 assume a change equal to a 50 percent decline in the quality index without abatement activities. As a test of the sensitivity of the results to the magnitude of this rate, the rate was varied from as much as 100 percent to as little as 25 percent. (Even without abatement activities, there may be some natural regeneration.) Given such a large variance in the rate of depreciation, the resulting estimates of depreciation did not vary significantly. The average incremental abatement cost per unit is derived by taking the ratio of current abatement expenditures to the incremental change in environmental quality. The incremental change in quality is equal to the index from the end of the current period minus the expected level of quality without further pollution abatement.

3. Jan van Tongeren and others, *Integrated Environmental and Economic Accounting: A Case Study for Mexico*, Environmental Working Paper No. 50 (Washington, D.C.: World Bank, December 1991).

BOX 2.
THE UNIFORM AIR QUALITY INDEX

The uniform air quality index is based on the five pollutants for which the primary National Ambient Air Quality Standards have been established, namely, particulate matter (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), and nitrogen dioxide (NO_2). A separate subindex for each pollutant is calculated from a function that transforms ambient concentrations into a scale from zero through 500, where a low number means low concentrations and a high number corresponds to significant harm levels. The so-called critical pollutant is based on the pollutant that has the highest subindex within or beyond the unhealthful range.

Reporting agencies in urban areas (a Census geographic delineation) maintain a daily index report based on the uniform air quality index. The report should contain the reporting area, the reporting period, the critical pollutant, the subindex corresponding to the critical pollutant, and the category describing air quality conditions from the following system:

0 to 50	Good
51 to 100	Moderate
101 to 199	Unhealthful
200 to 299	Very Unhealthful
300 and above	Hazardous.

Generally, the zone contained within the geographic boundaries of an urban area is sufficient for purposes of calculating and reporting the index. The exception occurs in cases where there is a significant air quality problem in highly populated areas adjacent to, but outside of, the urban area. For example, ozone concentrations are often highest downwind and outside the urban area.

SOURCE: *Code of Federal Regulations*, Title 40, Parts 53-60.

TABLE 8. ILLUSTRATIVE ESTIMATES: PLACING A VALUE ON DEGRADATION OF THE ENVIRONMENT FOR AIR AND WATER QUALITY

	Air Quality			Water Quality		
	Air Index	Change in Index (r=.5)[a]	Estimated Degradation (Billions of 1987 dollars)	Water Index	Change in Index (r=.5)[a]	Estimated Degradation (Billions of 1987 dollars)
1981	27.9	b	b	17.4	b	b
1982	29.4	13.9	13.5	18.1	8.7	10.7
1983	28.7	14.7	16.9	21.1	9.0	9.1
1984	28.9	14.4	15.4	25.3	10.6	8.8
1985	30.6	14.5	14.6	25.4	12.7	13.0
1986	30.7	15.3	17.1	25.5	12.7	14.0
1987	32.5	15.4	15.3	24.2	12.8	16.3
1988	31.1	16.3	19.1	23.0	12.1	15.8
1989	34.3	15.6	13.1	24.0	11.5	13.6
1990	37.0	17.2	12.2	24.9	12.0	14.3

SOURCE: Congressional Budget Office based on data provided by the Environmental Protection Agency and the Bureau of Economic Analysis.

NOTES: Estimates of degradation are calculated using data on pollution abatement expenditures from the Bureau of Economic Analysis, *Survey of Current Business*, various issues. Abatement expenditures are adjusted and used to estimate annual costs of abatement per unit of quality (a proxy for marginal abatement cost).

Air and water quality indexes have not been normalized and are not comparable.

a. Results assume that the index value measured at the end of the previous period will decline by 50 percent without additional pollution abatement activities. Differences between the baseline value and the actual index in the current year are attributed to pollution abatement activities. Estimates of degradation dollar values do not vary significantly when declines in index values ranging from 100 percent to 25 percent are used.

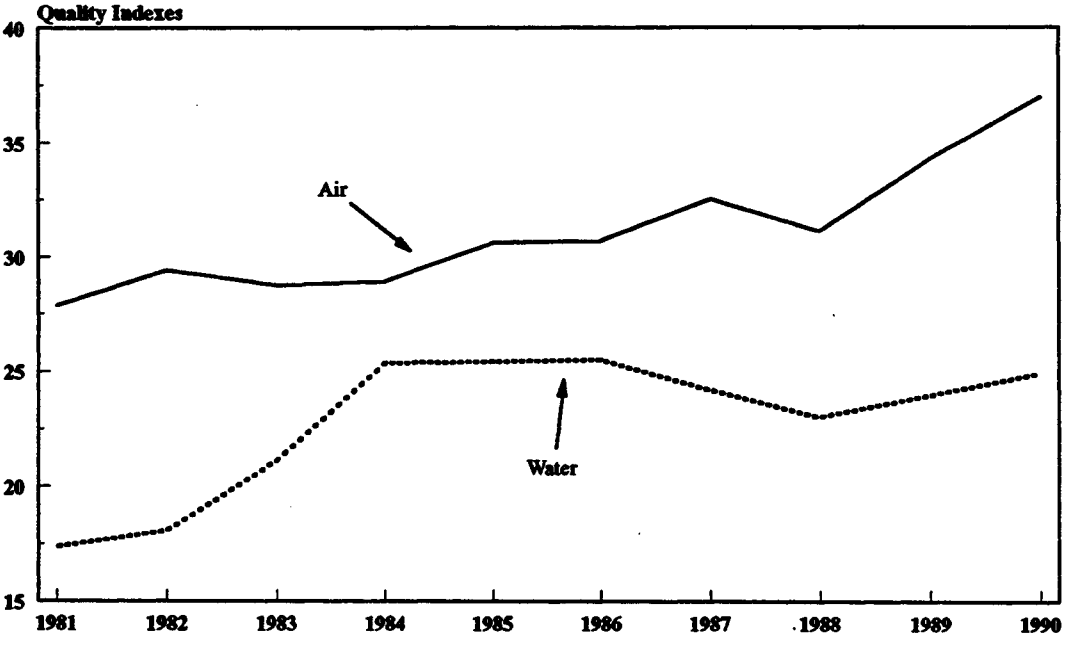
b. Not possible to compute change for the first year.

The value of environmental degradation can be expressed as an estimate of the amount that would have to be spent in the current period in order to maintain last year's level of quality. This is not an estimate of the cost of the change in the quality of the environment. It is simply an estimate of the costs associated with maintaining a level of quality. (This method is analogous to the methods used by the U.N. in pilot studies putting the System of Integrated Environmental-Economic Accounts into effect.) If expenditures in the current period are greater than the amount required to maintain last year's environmental quality, the result is additions to the stock of quality. That is, the current quality index is greater than last year's index, which implies an increase in the value of environmental stock. When environmental quality goes down, degradation figures exceed actual expenditures, reflecting a net loss in environmental quality. This happened in 1983 and 1988 for air quality and 1987 and 1988 for water quality (see Table 8).

According to this air quality index, the quality of the air increased somewhat in the 1981-1990 period. Air quality declined slightly in 1983 and 1988, bad years for ozone. Water quality, as measured by estimates of effluent discharges of BOD_5, increased significantly from 1982 to 1984, leveled off for two years, and declined somewhat from 1986 to 1988. Real abatement and control expenditures on air pollution grew from 1982 throughout the period and dropped somewhat in 1987. Real expenditures on water pollution abatement and control grew from 1982 through 1987 and fell in 1988 (see Figures 1 and 2).

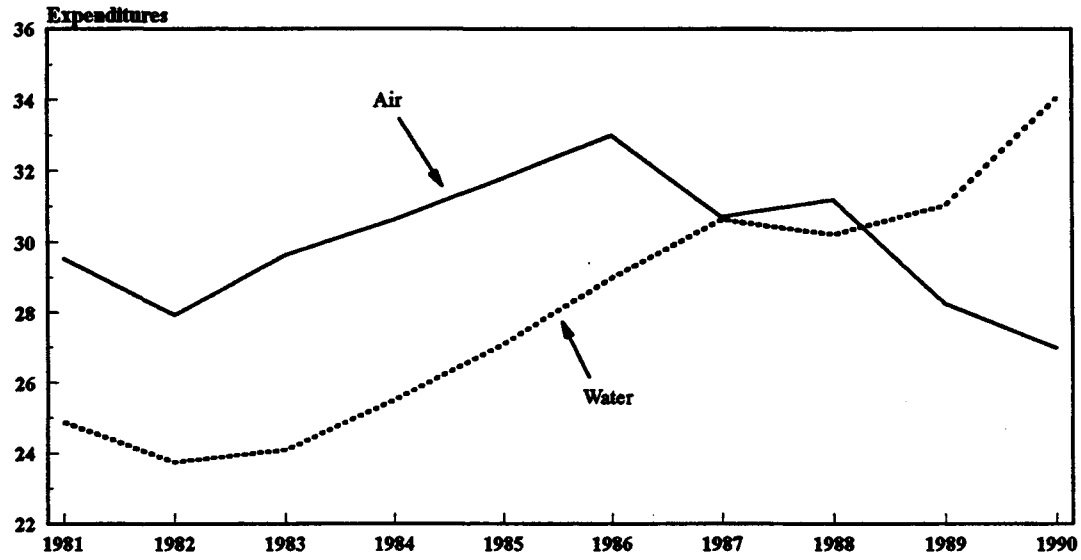
The results of this exercise highlight several interesting phenomena. First, estimates of degradation for environmental quality remain approximately constant at 1 percent of GDP during the 1980s. Environmental degradation allowances remain roughly at this level even under varying assumptions about the degradation rate--the amount by which quality would decline without any current-period expenditures on pollution abatement. The annual costs of maintaining environmental quality have been increasing during the decade--somewhat faster than GDP for water quality and slower than GDP for air quality. The upward trend in environmental costs can be attributed to the fact that the costs of maintaining a given level of quality become greater as national output and emissions increase. Moreover, the level of environmental quality was not just maintained but, according to these measures, increased over this period.

FIGURE 1. ESTIMATED AIR AND WATER QUALITY INDEXES, 1981-1990



SOURCE: Congressional Budget Office based on environmental quality data from the Environmental Protection Agency and population data from the Bureau of the Census.

FIGURE 2. EXPENDITURES FOR AIR AND WATER POLLUTION ABATEMENT AND CONTROL, 1981-1990 (In millions of 1987 dollars)



SOURCE: Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, various issues.

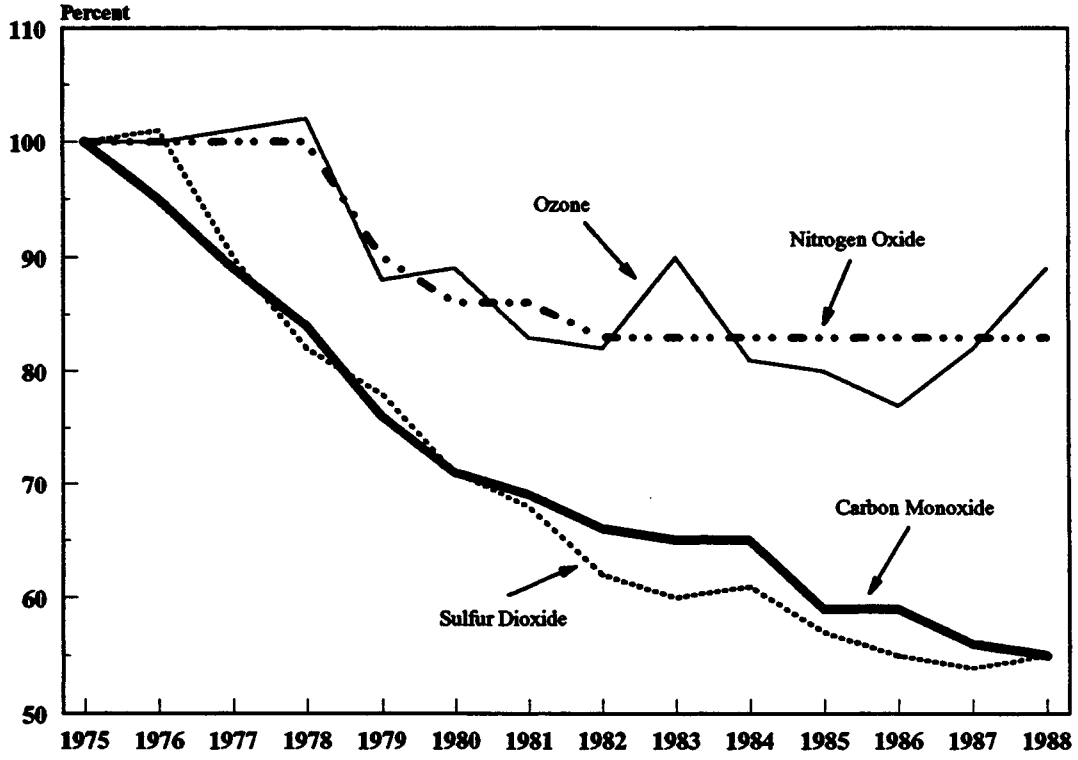
Assessing the Results

It is difficult to measure stocks or changes in stocks, regardless of whether or not market data for estimating prices exist. Better data are often available on emissions of pollutants than on changes in environmental quality. But a direct relationship does not always exist between emissions and changes in quality because there is some natural cleansing of pollutants.

Another difficulty in determining environmental degradation is that the components of a total index of environmental quality may not all move similarly (see Figure 3). Although most air pollutants show a decline, some have decreased at slower rates than others (ozone and nitrogen oxides) and some have periodically peaked upward (carbon monoxide and ozone). This difficulty may be overcome to some degree by forming several indexes based on health, ecological, and technological criteria. There are also regional differences in environmental quality that cannot be discerned from national indexes. If these differences (among various dimensions) affect estimates of degradation, they should be accounted for.

Similarly, there are no actual measurements of the physical stock of many renewable natural resources. One must rely on biological models to estimate additions to the stock. Reductions in nonrenewable natural resource stocks are the only numbers that can usually come directly from market data on how much is sold and estimates of losses resulting from natural disasters.

FIGURE 3. INDEXES OF NATIONAL AMBIENT CONCENTRATIONS FOR FOUR POLLUTANTS, 1975-1988 (1975=100)



SOURCE: Congressional Budget Office based on data from the Council on Environmental Quality, *Environmental Quality, 21st Annual Report* (1990), p. 323, Table 40.

CHAPTER V
CONCLUSIONS

The national accounts contain both summary measurements and detailed data. This information supports the three basic functions of the national accounts, namely, to provide an economic interpretation of changes in the nation's assets and national wealth, to furnish gauges of current income based on the actual or imputed market value of goods and services, and to measure financial and factor input flows in the economy.

Demands to add more information partly reflect concerns that the accounts do not adequately inform policymakers because of their limited treatment of natural resources and the environment. A comprehensive overhaul of the accounts to correct for all of those perceived deficiencies would require three kinds of revisions: (1) expanding the asset boundary to record changes in environmental quality and natural resource assets; (2) expanding the production boundary to include the services of natural resources and the environment that are not counted in measures of national income such as gross domestic product; and (3) reorganizing within the production boundary to identify more clearly the input of environmental factor service flows and the costs of reducing pollution damages counted in GDP.

Incorporating more information on natural resources and the environment into the accounts, however, requires much conceptual work and data gathering. Some or all of the three kinds of revisions to the accounts could be undertaken. An important guiding principle is whether there are data and techniques available that make some revisions easier to carry out than others. The most challenging problems that must be dealt with in incorporating more information into the accounts are (1) determining the most appropriate way of measuring physical changes in environmental quality and natural resource reserves and (2) developing reliable and consistent methods of pricing the nonmarket services of these assets.

Initial efforts by the United Nations and the Bureau of Economic Analysis, which are meant to improve understanding of how best to incorporate natural resources and the environment into the accounts, have relied to a large extent on market data. These efforts concentrate on two types of revisions of the accounts: determining the monetary value of depletion of nonrenewable resources and identifying abatement expenditures designed to reduce pollution damages.

The efforts of the U.N. and BEA are logical first steps in addressing criticisms of the accounts' treatment of natural resources and the environment. Such efforts could make the accounts more useful for analyzing the links between environmental and natural resource policies and employment, trade balances, and growth of GDP. And measurement problems associated with deriving imputed or inferred prices are not as significant for nonrenewable resources as they could be for renewable natural resources and the environment.

Efforts to go beyond the first steps, however, will involve a greater reliance on imputed prices for nonmarketed flows as well as overcoming difficulties in measuring changes in environmental quality or natural resource reserves. Such data--if accurate and consistent with other data in the accounts--could make the accounts even more useful for analyzing the links between the environment and natural resources and the economy. In addition, such data could be used to produce alternative measures of national income such as a "green" GDP and could be part of the data set necessary to measure sustainable income.

If data are not sufficiently accurate and precise, however, their incorporation could weaken rather than enhance the ability of the accounts to inform policymakers. This is an important consideration because the techniques for placing a value on nonmarket services continue to generate controversy.

Nevertheless, it may be feasible to expand the information on natural resources and the environment beyond that provided by market, especially for imputing the value of factor services such as environmental waste disposal and certain final services such as publicly provided recreation.

APPENDIX A

DEVELOPMENT OF THE NATIONAL ACCOUNTS

The first component of the national accounts to be included in government documents available to the general public was the national income and product accounts (NIPAs). NIPAs are a double-entry system that reports income on one side of the ledger (wages and salaries, capital consumption, interest, proprietor income, dividends, rents, and indirect taxes, plus some additional minor items) and expenditures on the other, or product side. The product side reports final demand for goods and services, including government spending, private investment, net exports, and consumption expenditures. These variables were first identified as part of a unified system by British economist John M. Keynes.[1] Simon Kuznets, a Ukranian-born U.S. economist, first conducted extensive measurements of these variables.[2]

Subsequent additions to the national accounts--the input-output (I-O) accounts (1947) based on the work of Wassily Leontief, the flow of funds accounts (1962), which grew out of Morris Copeland's efforts, and the balance sheets (1980) patterned after those developed by Raymond Goldsmith--adopted the same basic design of explaining economic activity on the basis of actual and imputed prices.[3]

The involvement of the federal government with national economic accounting began on a continuing basis in 1932 with S.220, which called for the Department of Commerce to prepare estimates of annual national income.[4] These estimates, most of which were made by Simon Kuznets at the National Bureau of Economic Research, were first published in *National Income, 1929-32*.[5] This work was well received and various groups, including the Committee on Government Statistics and Information Services--an

1. John M. Keynes, *General Theory of Employment, Interest and Money* (New York: Harcourt, Brace Inc., 1936).

2. Simon Kuznets, *Seasonal Variations in Industry and Trade* (New York: National Bureau of Economic Research, 1933).

3. Wassily W. Leontief, *The Structure of the American Economy, 1919-1929* (Oxford: Oxford University Press, 1941); Morris Copeland, *A Study of Money Flows in the United States* (New York: National Bureau of Economic Research, 1952); Raymond Goldsmith, *National Wealth of the United States in the Postwar Period* (Princeton, N.J.: Princeton University Press for the National Bureau of Economic Research, 1962).

4. *Congressional Record*, vol. 75, 72nd Congress, 1st Session (1932), p. 12285.

5. Senate Document 124, 73rd Congress, 2nd Session (1934).

independent advisory panel sponsored by the American Statistical Association and the Social Science Research Council--urged that the Commerce Department be given responsibility for producing such information annually.

The Commerce Department developed the first versions of the NIPAs during World War II in response to Congressional and White House demands for information on how large a rearmament program the U.S. economy could support and where bottlenecks might occur. The success in providing this information firmly established national accounting as a valuable framework for analyzing the performance of the economy. Indeed, confidence in NIPA was great enough by the end of the war to make its mere existence a factor in the passage of the Employment Act of 1946. This act created the President's Council of Economic Advisors and the Joint Economic Committee of Congress to help formulate reconversion policies in the postwar period.

The United States has always been at the forefront of efforts to encourage the worldwide adoption of consistent national accounting practices. Even before the end of World War II, representatives of the British, Canadian and U.S. governments met to develop comparable concepts and modes of presentation. These discussions resulted in the first international agreement on national economic accounting practices and, in 1947, the publication of an expanded set of NIPAs. The United States was also instrumental in the formation of a national income unit at the United Nations. This unit first published the U.N.'s own System of National Accounts (SNA) in 1952, although most of the work was actually conducted under the direction of U.S. economist Richard Stone for the Organization for European Economic Cooperation.

The national economic accounts have never been--and probably never will be--a finished product. The amount of data needed to portray the economy is constantly increasing as new products and services are developed. But the main reason that the accounts will never be complete is that the number of policy issues requiring information at the macro, or national, level is constantly expanding.

When the NIPAs were first being developed in the 1940s and 1950s, policy was focused almost exclusively on short-term management of the economy. By the mid-1950s, however, policymakers were demanding better information for longer-term planning. The Bureau of Economic Analysis (BEA) responded in 1958 by expanding the data included in the input-output accounts. Equity issues became more prominent in the late 1960s, and statistics on income and wealth distribution were also added to the accounts.

In addition, by 1964 the I-O accounts introduced in the 1950s were fully integrated with NIPA.

The 1970s--a period of recession and relatively high rates of inflation--saw improvement in the Federal Reserve's flow of funds accounts and more detailed estimates of constant dollar flows. During this same period, BEA developed alternative estimates of depreciation based on uniform service life and straight-line depreciation. BEA also began reporting survey data on expenditures for pollution abatement during this decade.

A major policy concern during the 1980s and early 1990s has been the slower rate of economic growth compared with earlier postwar periods. Renewed interest in identifying the sources of national growth has resulted in improvements in the national economic accounts. Two notable changes have been the introduction of the balance sheets and BEA's switch from gross national product (GNP) to gross domestic product (GDP) as the primary measurement of national output. The first change reflected an increasing awareness of the need to keep track of the nation's assets. GDP was given an increased prominence because it is a better measurement of the national output than GNP, which includes foreign earnings of Americans and excludes earnings by foreign nationals in the United States. BEA has also developed estimates of flows, stocks, and depreciation for consumer durables and publicly owned fixed capital using alternative estimates of service life, depreciation, and valuation as well as more detailed data on foreign transactions.

APPENDIX B

THE ASSET BOUNDARY IN THE UNITED NATIONS' REVISED SYSTEM OF NATIONAL ACCOUNTS

The United Nations has redefined the asset boundary in its newly revised System of National Accounts (SNA). In addition, the U.N. will maintain a system of environmental economic accounts that contains information not included in gross domestic product (GDP) or net domestic product (NDP).

The United Nations' draft of the revised SNA classifies environmental and natural resource assets as either produced, nonproduced, or not considered in the accounts--that is, outside of the asset boundary. According to the SNA's discussion of the first two assets,

> the . . . asset boundary is determined . . . by whether the assets are subject to effective ownership and are capable of bringing economic benefits to their owners, given the existing technology, knowledge, economic opportunities, available resources and set of relative prices. Environmental assets over which ownership rights have not, or cannot, be established, such as seas or air, are excluded.[1]

Produced natural resource assets are fully integrated into the accounts. That is, the balance sheets record their market value, GDP counts the market value of their flow of services, and the difference between GDP and NDP includes the economic depreciation of these assets unless they are considered part of inventories. Cultivated biological resources, such as privately managed forests and fisheries, constitute the bulk of these assets in the United States.

Nonproduced assets consist of assets that are needed for production but have not been produced. The most important are land, mineral deposits, noncultivated biological resources, and water resources. Although they must actually be owned by institutional units, their renewal is not "under the direct control, responsibility and management of those units."[2] Nonproduced environmental and natural resource assets are not integrated fully into the accounts. The balance sheets record their market value and GDP counts the market value of their flow of services, but the consumption of fixed capital does not include the amount of their depreciation.

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1. United Nations, *Draft Revised Version of the System of National Accounts* (New York: United Nations, 1992), Chapter 13, p. 4. See also Chapter 10, pp. 2-4; Chapter 10, p. 5; and Chapter 12, p. 3.

2. Ibid., Chapter 10, p. 3.

In addition, the revised SNA eliminates losses and discoveries from consumption of fixed capital. For example, both the SNA and the U.S. national income and product accounts treat an oil spill that damages marine ecosystems differently than they do a hurricane that damages housing. Both the negative and positive effects of the hurricane are counted in conventional NDP. (Reductions in national wealth and income are negative because housing is destroyed and rental income is decreased. The increase in current income is positive because people are put to work restoring the housing.) Only the positive effects (the cleanup activity) of an oil spill are counted. Certain negative effects of an oil spill, such as a reduction of service flows because of damages to the ecosystem, are not counted in either the current SNA or the current U.S. accounts.

The U.N. proposes to correct this asymmetry by recording accidental loss of all capital in a satellite account (the "other changes" account). For the purpose of computing NDP, however, the treatment is still tantamount to assuming that the loss of national assets never happened.

Economic activity to correct this asymmetry may be better reflected by recording the loss of wealth caused by an oil spill in the same capital account where housing losses are currently recorded. If these data are used to compute a "sustainable" NDP, recording the negative effects of oil spills in the capital accounts would enable the accounts to produce a more complete picture of the relationship between current economic activity, future economic conditions, and the environment.

APPENDIX C

CHANGING THE ACCOUNTS WITHIN CURRENT PRODUCTION AND ASSET BOUNDARIES

Some proposed changes that would affect gross domestic product (GDP) and net domestic product (NDP) involve a reclassification of items within the production and asset boundaries rather than an expansion of the boundaries. Nevertheless, because these changes could affect the size of GDP or NDP they may influence perceptions about the success of public policies. Two proposals of this sort concerning environmental and natural resources are (1) to eliminate defensive expenditures on natural capital from GDP by redefining them as intermediate expenditures and (2) to treat certain environmental and natural resources as inventories rather than fixed capital.

ELIMINATING DEFENSIVE EXPENDITURES ON NATURAL CAPITAL FROM GDP

One criticism of the current method of accounting is that many of the costs of preventing, reversing, or avoiding the effects of environmental and natural resource degradation--the so-called defensive expenditures on environmental and natural resources--cause GDP to increase.[1] Pollution is a common source of degradation, but other activities--such as harvesting of timber and fish and soil depletion from farming--can also cause problems. A typical description of defensive expenditures is expenses "to compensate for, redress or guard against" degradation. Critics of the current treatment of these expenditures offer two arguments. First, the current treatment of defensive expenditures is arbitrary and inconsistent. Second, GDP should rise only when the country spends money on something good, not when it must spend money to avoid or correct for something that detracts from the nation's welfare. A frequently suggested method of handling these expenditures, originally proposed by economists Simon Kuznets and Thomas Juster, is to classify all defensive expenditures as intermediate, thus reducing GDP and

1. See Roefie Hueting, "Correcting National Income for Environmental Losses: Toward a Practical Solution," in Yusuf Ahmad, Salah El Serafy, and Ernst Lutz, eds., *Environmental Accounting for Sustainable Development* (Washington, D.C.: World Bank, 1989).

"conventional" NDP by the amount of these expenses.[2] France, Japan, and Germany have suggested such modifications in international meetings.[3]

Issues

The charge that the current treatment of defensive expenditures is arbitrary and inconsistent is part of two definitional questions that constantly arise in national income accounting: (1) the dividing line between intermediate and final goods and services and (2) the dividing line between investment and maintenance expenditures.

Intermediate Versus Final Goods Issue. The Department of Commerce's working definition of an intermediate good or service is an item that is purchased and then resold domestically by businesses (firms, nonprofit organizations, and government enterprises). Specifically, intermediate products consist of goods and services purchased by businesses on current account except for additions to inventories.

Critics of this definition for determining which expenditures to exclude from GDP point to the inconsistencies that often result. For example, under this rule, GDP is lower if an employee's business expenses are paid by the employer than if the employee pays them himself but gets a higher salary by way of compensation. The best way to think about this is to assume that the total level of economic activity--intermediate plus final goods and services--is fixed. GDP measures only final goods and services; therefore, the more of this economic activity that is classified as final, the greater GDP. GDP equals expenditures by consumers, investors, and governments or, alternatively, wages and salaries, profits, rents, interest, and indirect business taxes plus capital consumption. In this example, the reimbursed business expenses are not counted in any of these categories, but expenses paid by the employee who gets a higher salary are added to the expenditure side and salary and wages to the factor payments side. As a result, GDP is higher with the latter treatment because a greater percentage of total economic activity has been defined as expenditures on final goods and services. Eliminating all defensive expenditures on environmental and natural resources from GDP, regardless of who made them, is one way of reducing the number of inconsistencies.

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2. F.T. Juster, "A Framework for the Measurement of Economic and Social Performance," in Milton Moss, ed., *The Measurement of Economic and Social Performance*, vol. 38 of *Studies in Income and Wealth* (New York: National Bureau of Economic Research, 1973). For a good evaluation of the different approaches, see Henry Peskin and E. Lutz, *A Survey of Resource and Environmental Accounting in Industrialized Countries*, Environment Working Paper No. 37 (Washington, D.C.: World Bank, 1990).

3. Peskin and Lutz, *A Survey of Resource and Environmental Accounting*, p. 7.

Investment Versus Maintenance Expenditures. The Bureau of Economic Analysis's definition of final and intermediate products also provides an easy, if not always accurate, solution to a problem that business and tax accountants constantly face--distinguishing between investment and maintenance expenditures. Maintenance activities--such as changing the oil in an engine--are usually defined as expenditures necessary to sustain or facilitate economic activity. Since they are a precondition for production, they are considered to be intermediate rather than final products.[4] Another argument for excluding from GDP all defensive expenditures for environmental and natural resources is that they bear a closer resemblance to maintenance than to investment because a clean environment and the availability of natural resources can be considered necessary preconditions for production.

Assessment of Issues

The most frequently cited argument in favor of the defensive expenditure approach is that it eliminates the possibility that increases in pollution will raise GDP. However, GDP as it is now calculated may also rise as a result of other undesirable events such as natural disasters or war. And excluding all defensive expenditures from GDP could discourage policymakers from spending money on environmental cleanup, because GDP would end up being lower than if they had allocated resources to activities that are counted.

Another issue is concerned with how to classify consumption purchases of goods or services that can be used to protect against environmental harm but have other purposes as well. Purchases of face masks or special filtering devices on air conditioning systems are examples of defensive expenditures. These types of expenditures could be reclassified as intermediate inputs (in the production of environmental protection) and deducted from final expenditures, thereby reducing GDP. The challenge of this approach lies in deciding which kinds of purchases are mostly defensive in nature because a good is often purchased for other attributes as well as its ability to ameliorate environmental harm.

If all defensive expenditures on environmental and natural resources were excluded from GDP, it would also raise the question of whether other defensive expenditures--government outlays for national defense, fire and police protection, street cleaning, road maintenance, and a substantial part of

4. Robert Eisner, "Extended Accounts for National Income and Product," *Journal of Economic Literature*, vol. 26, no. 4 (December 1988), pp. 1611-1684.

household expenses, including commuting and health care costs--should also be excluded.

Moreover, if all defensive expenditures were eliminated from national income, it would not make GDP a better measure of welfare, but would leave it much less comprehensive and therefore less valuable for analyzing the effect of macroeconomic policies on total employment and inflation. The reason is that a smaller amount of the economic activity that ultimately determines employment levels would actually be included in the measure of national output. This view was expressed by Richard Ruggles when he argued, "We need to make gross national product even grosser than it is, and to recognize that it does not correspond to a measurement of welfare but rather provides a body of data useful to the economic analyst in understanding the behavior of the economy."[5]

The problem with the current treatment of defensive expenditures on environmental and natural resources is that its information is asymmetrical. That is, the expenditures to prevent or restore environmental and natural resource degradation are added to GDP but the decline in the value of future services is not subtracted in computing NDP.[6] The reason for the asymmetry is that the balance sheets lack any entry for consumption of natural resources and environmental services. One way to correct for this asymmetry is to treat these resources as a form of "natural" capital that is augmented by "investment" expenditures to protect and restore the asset, but diminished in the production process or by accidental losses.

TREATING ENVIRONMENTAL AND NATURAL RESOURCES AS INVENTORY

An important conceptual question in incorporating environmental and natural resources into the asset boundary is what to treat as inventory rather than fixed capital. The International Association for Research on Income and Wealth, for example, recommended the inventory approach to the Organization for Economic Cooperation and Development at its May 1992 meeting.[7] Resolution of this issue is important because it influences the size of NDP in relation to GDP and, possibly, estimates of the level of savings consistent with sustaining national income.

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5. John W. Kendrick, *Economic Accounts and Their Uses* (New York: McGraw-Hill, 1972), p. 27.

6. See Hueting, "Correcting National Income for Environmental Losses," p. 33.

7. Carol Carson, Director, Bureau of Economic Analysis, personal correspondence, January 22, 1993.

The Issue

The asset boundary includes both fixed capital and inventories. Assets are valued at the current price multiplied by quantity; the value of fixed capital is the discounted contribution to future GDP. Changes in the value of inventories are recorded in GDP; changes in the value of fixed capital due to use or accidental loss are recorded as capital consumption and used to compute NDP.

The revised guidelines for the United Nations' SNA defines a fixed asset, for example, as one that is used "repeatedly or continuously in production." They define inventories as "used up in production as intermediate consumption, sold, or otherwise disposed of." The only natural resources that the SNA currently includes as inventory are privately owned forests that are not ready to harvest, although the definition could be expanded.[8]

Assessment of the Issue

The main argument in favor of treating natural capital as an inventory is that changes in the value of inventories would affect GDP, the most widely used indicator of economic welfare. One compelling argument against classifying major categories of natural capital as inventory is that it confuses the role of GDP and NDP. GDP measures current economic activity. A $50 billion addition to oil reserves, when the oil has not actually been taken out of the ground, does not qualify as current activity, and therefore some argue that it should not be counted in current GDP. The addition to reserves does, however, qualify as an addition to wealth.

8. United Nations, *Draft Revised Version of the System of National Accounts* (New York: United Nations, 1992), Chapter 13, pp. 4 and 11; Chapter 21, p. 54.